Energy community ex-post electricity and cost allocation in practice – the Austrian example

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Overview

EU member states are obliged to transpose the individual directives of the *Clean Energy for All Europeans Package* [1] into national legislation within a timeframe of at maximum 2 years. Among a variety of different topics, the *Electricity Market Directive* [2] and the *Renewable Energy Directive* [3] encompass regulatory guidelines for Renewable Energy Communities (RECs) and Citizen Energy Communities (CECs). These two types of energy communities (ECs) should enable energy exchange across the border of individual buildings or properties. The transposition process of the EU guidelines to enable RECs and CECs is at different stages in the individual member states. While some member states have not even proposed a legislative draft, others have at least partly transposed regulation for RECs and CECs. Austria, having a full transposition of regulations for RECs and CECs in place since mid 2021, therefore takes a pioneer role in Europe.

When ECs are put into practice the first time, a number of issues arise that need to be addressed iteratively. In the Austrian case, one of these issues arises out of the fact, that the distribution system operators (DSOs) are legally obliged to perform the electricity allocation between participants within an EC, using a static or dynamic allocation key. From the DSO, ECs receive data regarding the amounts of electricity that individual participants received from the community, and, vice versa, the amount of electricity a generation unit/a prosumer delivered to the community. Thereby, it is not known, which participant received which exact amount of electricity from which generation unit/prosumer, or which generation unit/prosumer delivered which exact amount of electricity to which of the other participants. However, this kind of information would be of crucial importance when it comes to ECs' individuality – for example a certain prioritisation regarding the inner-community electricity purchase, or applying peer-to-peer pricing (individual prices from one peer to another peer). This issue can be addressed by proposing ex-post electricity allocation algorithm for ECs, which is introduced in this work..

Methods

The ex-post electricity allocation algorithm is based on prioritisation. Each participant can declare one other participant (with a PV system) from whom electricity purchase is preferred. This information is summarised in an array of ones (prio) and zeros (non-prio). The simulation is then modelled as follows: For each timestep it is determined whether a participant with a PV system has sold electricity to his community peers (can be derived from the data that is provided by the DSO). If so, this amount of PV generation is divided by the number of peers, who prefer to purchase electricity from this very participant, so that each has the chance to obtain an equal share of the respective PV generation. If the purchasing participants' loads are larger than or equal to the allocated amount of PV electricity, they fully use their share, if not, only the needed amount of PV electricity is allocated, whereas the residual amount remains available for the further allocation process. After the first round of prioritised allocation, this process is re-run as long as any of the participants prefers to purchase electricity from another peer who still has electricity available for allocation. As soon as the prioritised allocation is done, the residual PV electricity is allocated to the remaining loads (this is then the part of non-preferred allocation).

Results

The method is applied to a ficitious EC of 4 single-family houses. Their annual load ranges between 2663kWh and 8635kWh. Two of the participants (participants 1 and 3) are equipped with rooftop PV systems, oriented south and west. It is assumed that the participants pay 20c/kWh for electricity purchase from the conventional supplier. Electricity within the community is sold for 7c/kWh or 9c/kWh (preferred and not-preferred electricity purchase). It is assumed that participants 1 and 4 prefer to buy PV electricity from participant 3, and participants 2 and 3 prefer to buy electricity from participant 1.

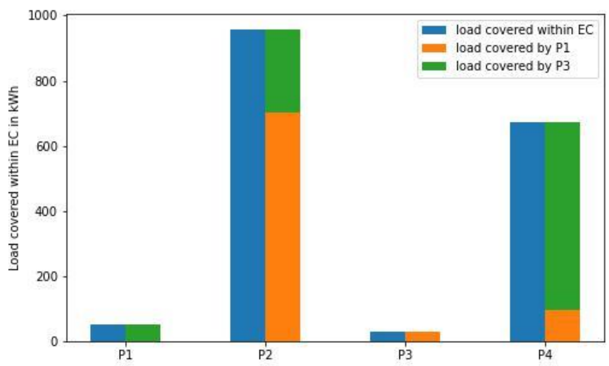

Figure 1 shows how much of the annual load covered within the EC (the total amount is in this case determined by static electricity allocation from the DSO) is covered by electricity purchase from which peer. According to the preferences, participant 2 receives the majority of PV electricity from participant 1, and participant 4 receives the majority of electricity from participant 3. Inner-community load coverage for participants 1 and 3 (with PV system) is generally low, (i) since they do already cover significant parts of their load through direct consumption, and (ii) due to a certain simultaneity of PV generation.

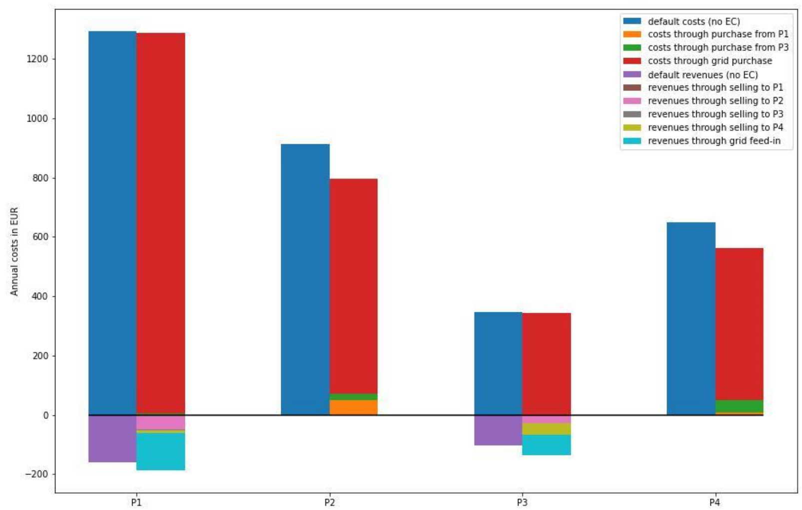

Figure 2 shows a comparison of costs and revenues (negative costs in the Figure 2) for the case with and without an EC being established. For participants 2 and 4 costs decrease significantly. For participants 1 and 3 costs decrease insignificantly (due to the very limited amount of electricity purchased within the EC), but their revenues increase (due to selling to community peers) instead of simply being fed into the grid for a small feed-in-tariff.

Conclusions

In order to achieve a certain kind of individuality for energy communities – if legislation is similar or equivalent to the Austrian case – building knowledge regarding ex-post electricity allocation will be crucial in the near future. There are multiple ways how ex-post electricity allocation can be implemented. In this study, insights into one specific possibility based on priritisation are provided. From the results in this study, not only information regarding how to set up such ex-post electricity allocation can be derived, but also insights regarding the relation of implementation and programming efforts in contrast to the actual (financial) value for ECs can be derived.

References

[1] European Commission; Clean energy for all Europeans package; 2019; https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en
[2] EUR-Lex; Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU; 2019
[3] EUR-Lex; Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources; 2018